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Distribution of
Carbon Monoxide and C_1-C_4 Hydrocarbons
in the Northeastern Portion of the Bering Sea
During the Summer of 1977

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A joint US-USSR cruise with the intent of comparing sampling methods and instrumentation and obtaining baseline values of various chemical properties was held in the Bering Sea in July and August 1977. This report deals only with the C_1-C_4 hydrocarbons and CO found in the water column. The stations can be divided into open-ocean, near-shore, and transition stations. The open-ocean stations exhibit the same type of trends found in other open-ocean areas, but concentrations are higher. The near-shore or shallow-water stations exhibited very high concentrations, as would be

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20. Abstract (Continued)

expected due to the high biological activity and proximity of the sediment to the water surface. The Bering Sea area overall exhibited higher hydrocarbon concentrations but the same type of trends found elsewhere in the world oceans.

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DISTRIBUTION OF CARBON MONOXIDE AND C_1-C_4 HYDROCARBONS
IN THE NORTHEASTERN PORTION OF THE BERING SEA
DURING THE SUMMER OF 1977

INTRODUCTION

In accordance with the directives of the US–USSR Joint Committee on Cooperation in the Field of Environmental Protection, Biosphere Reserves Section, Area V, a cruise was conducted in the Bering Sea during July and August 1977. It was a joint US–USSR cruise with the intent of comparing sampling methods and instrumentation and obtaining baseline values of various chemical properties. The following report will contain only information about carbon monoxide and the C_1-C_4 light hydrocarbons, with interpretation of the data solely based on sample locations, temperature, and salinity data.

There continues to be a need to establish baseline concentrations of low-molecular-weight hydrocarbons in the world oceans. This is especially true in areas where there are large fisheries, as in the Bering Sea. This information will be useful in assessing the extent of man-induced pollution in the ocean environment. It is also needed to enable us to assess the biogenic input of these hydrocarbons and thereby approach the problem of pollution control in an enlightened manner.

ANALYTICAL AND SAMPLING PROCEDURES

The hydrocarbon measurements were made by gas chromatography on board ship. In this technique the dissolved hydrocarbons are first purged from solution by purging with helium and are then concentrated in cold traps containing appropriate absorbents. They are subsequently released by an increase in temperature and swept into the gas chromatograph by a second stream of helium carrier gas. With this method, sample size is not restricted, and very dilute solutions may be analyzed.

Two cold traps at $-77°C$ were used in series. In the first cold trap activated alumina was used to trap all hydrocarbons except methane and carbon monoxide; in the second a mixture of activated charcoal and molecular sieve was used to trap methane and carbon monoxide. When the purging was complete, the traps were isolated by closure of appropriate valves, and their temperature was raised to approximately $90°C$. Helium carrier gas was then used to strip in turn each of the adsorbed gases and to carry these gases into the chromatograph for further separation and analysis. A 1.2-meter column containing activated alumina with 10% Nujol was used to separate low-molecular-weight hydrocarbons other than methane. Methane and carbon monoxide were separated on a molecular sieve column [1,2].

For the light hydrocarbons the absolute sensitivity of the method is approximately 2×10^{-12} mol. On the basis of 1-liter water samples, this sensitivity corresponds to 5×10^{-8} ml of dissolved gas at standard temperature and pressure per liter of seawater. At this lower limit the precision of the method, on the basis of replicate measurements under laboratory conditions, is ±10%. For quantities of gas greater by a factor of 10 or more, the precision improves to ±1.0%. Additional error incurred during field operations may increase this spread in uncertainty. The chromatograph was calibrated with a commercially available gas mixture containing known amounts of the hydrocarbons in question.

Water samples for hydrocarbon and carbon monoxide analyses were obtained from 1.7-liter Niskin bottles mounted on a Rosette sampler that was attached to the main pumping systems. The samples were drawn in the same manner as oxygen samples into 1.2-liter Pyrex bottles with tapered ground-glass joints. The samples were immediately put in the dark and analyzed as soon as possible, usually immediately after the sampling at a station was completed. The bulk of water samples for the other analyses were taken using an Interocean pumping system. However, the pumping system was not used for the hydrocarbon samples because of contamination of water samples with butane and higher organic compounds from a short section of rubber garden hose used as the termination point for the pumping system.

Figure 1 shows the approximate cruise track, and Table 1 lists the station positions. There were 24 stations, which were occupied twice with approximately 8 days between sampling periods. Thus station 1 became station 25 when occupied the second time. Those stations which lie roughly east-west were 30 nautical miles apart. Sampling depths were 0, 10, 25, 50, and 75 meters, except where the bottom depth was less than 75 meters.

RESULTS

Based on the temperature, salinity, and methane concentrations, three water zones were recognizable in the sampling area. The first was an open-ocean portion of the cruise track, consisting of (Fig. 1) stations 1 through 11 (and 25 through 35), 13 (and 37), 23 (and 47), and 24 (and 48). The second was a shallow section ($\approx$40 m), consisting of stations 15 through 20 (39 through 44). The third was the transition zone between the other two zones, consisting of stations 12 (and 36), 14 (and 38), 21 (and 45), and 22 (and 46). Figures 2, 3, and 4 show selected methane (ml/liter), temperature (°C), and salinity ($^{\circ}/_{\circ\circ}$) profiles of these three zones. Each variable is plotted in an individual figure rather than simultaneously to emphasize the differences between the three water zones.

The stations characteristic of open-ocean conditions (1-11, 13, 23-35, 37, 47, and 48) comprise the largest area and number of stations. The sampling depths are found in water which appear to be sufficiently removed from the influence of the sediment/water interface, since the dissolved-gas concentrations (Appendix) at the open-ocean stations are characteristic of midocean values. The sampling depths did not extend to the bottom of the water column; hence there is no way of determining whether the colder waters at depth would exhibit light hydrocarbon concentrations similar to those in the cold shallow-water environment.

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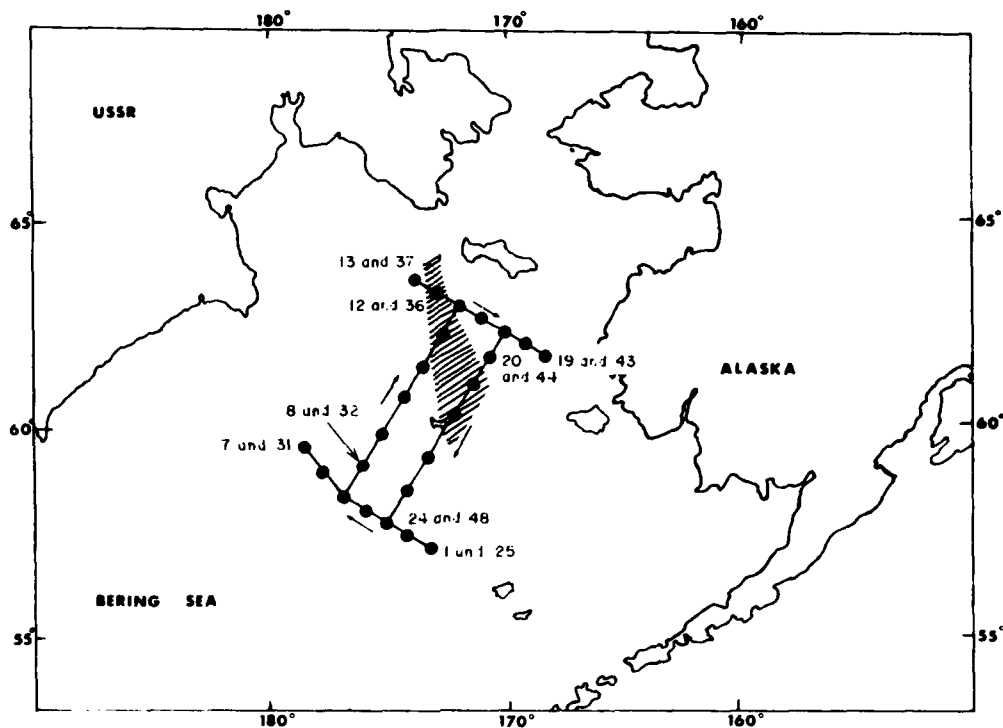
Fig. 1 -- Double-transit cruise track of the RV Volna, with the numbers indicating the sequence of station occupancy. The shaded area and the two areas left and right of it are three environmental zones characterized by the results.

Table 1 -- Position of stations occupied (Fig. 1) as supplied by Russian ship personnel. The second occupancy of a station is listed on a second line when the reported position differs by more than 1 or 2 minutes from the reported position of the first occupancy.

Station	Position	Station	Position
1, 25	57°30′N, 173°20′W	11, 35	61°20′N, 173°12′W
2, 26	57°45′N, 174°10′W	12, 36	62°02′N, 172°17′W
3, 27	57°59′N, 175°00′W	13, 37	63°00′N, 173°40′W
4	58°30′N, 175°50′W	14, 38	62°45′N, 172°40′W
28	58°15′N, 175°50′W	15, 39	62°30′N, 172°40′W
5, 29	58°30′N, 176°40′W	16, 40	62°15′N, 170°50′W
6	59°00′N, 177°25′W	17, 41	62°00′N, 170°00′W
30	59°01′N, 177°18′W	18, 42	61°45′N, 169°05′W
7	59°35′N, 178°10′W	19, 43	61°30′N, 168°10′W
31	59°30′N, 178°10′W	20, 44	61°35′N, 170°35′W
8, 32	59°12′N, 175°48′W	21, 45	60°49′N, 171°32′W
9, 33	59°55′N, 174°56′W	22, 46	60°06′N, 172°28′W
10	60°37′N, 174°12′W	23, 47	59°25′N, 173°21′W
34	60°37′N, 174°05′W	24, 48	58°41′N, 174°10′W

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Fig. 2 — Vertical profiles of methane concentrations from the "open ocean" (stations 3 and 27), intermediate zone (stations 14 and 38), and shallow water (stations 15 and 39, with each plot showing the profiles of the two stations taken at the same coordinates
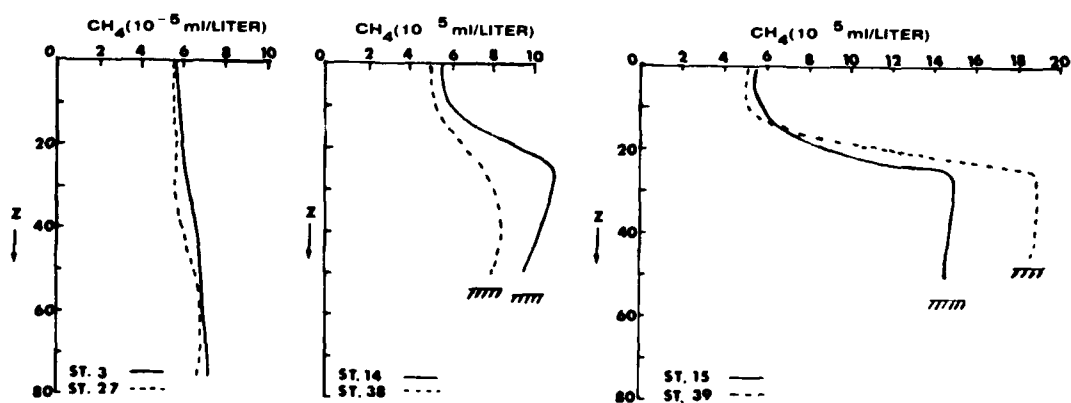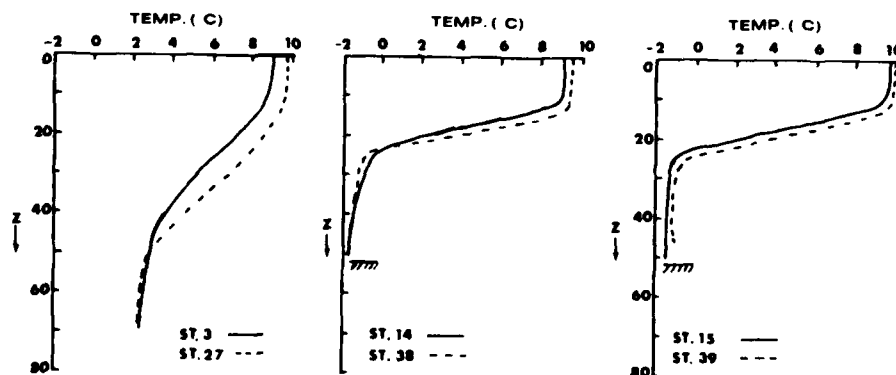

Fig. 3 — Vertical profiles of temperature under the same conditions as in Fig. 2

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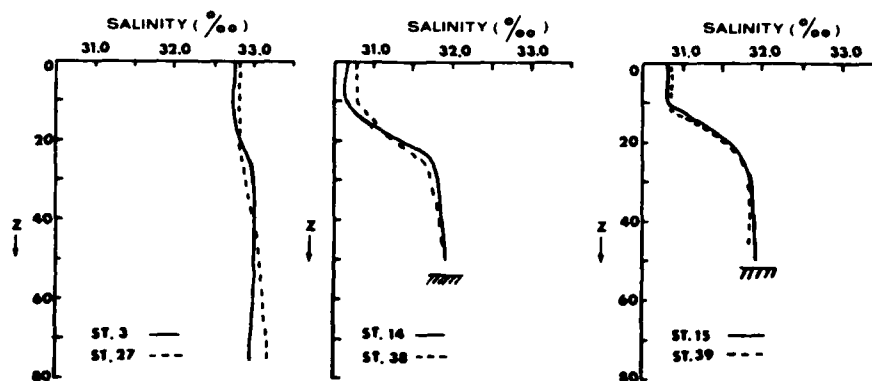
Fig. 4 — Vertical profiles of salinity under the same conditions as in Fig. 2

Methane values in the open-ocean zone are supersaturated at almost all depths. Methane (CH_4) does not exhibit any subsurface maxima as is generally found under other open-ocean conditions. Ethane and propane (C_2H_6 and C_3H_8) also show no subsurface maxima and decrease in concentration with depth, whereas methane remains fairly constant. The unsaturates, ethylene and propylene (C_2H_4 and C_3H_6), exhibit subsurface maxima at various stations. The butanes (iso and normal) are present in only trace amounts at all the stations and will not be discussed.

The second major grouping of stations (15-20, 39-44) comprise the shallow-water environment. There is an extremely sharp thermocline at approximately 10 meters. The saturated hydrocarbons, methane, ethane, and propane, are extremely high below the thermocline. Supersaturation for methane is as high as 300% at selected depths (usually the bottom sample). The unsaturated hydrocarbons resemble the distribution found in the open-ocean zone.

The intermediate zone (12, 14, 21, 22, 36, 38, 45, 46) is a transition between the other two zones. Thus the vertical profiles of the hydrocarbons shift as one moves from the shallow-water environment to open-ocean conditions. These stations were chosen based on the methane data (Fig. 2) and the thermocline depth and sharpness and are thus subject to some interpretive bias.

Carbon monoxide concentrations are extremely variable throughout the sampling areas. There is no set pattern to the CO distribution with the available ancillary data. The randomness will be considered further in the discussion.

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DISCUSSION

A major difficulty arises from the reoccupancy of each station with a time delay of approximately 8 days between samplings. The tendency is to consider the two samplings as duplicates when in fact they are not. In some cases the results agree quite well, and in others the agreement is poor. The reasons for disagreement between the reoccupied stations can be easily explained. The stations were occupied at different times of the day and under varying weather conditions. If the weather variations were strong and very localized, then we would not have had to be very far off the station for the data to vary. The current direction is counterclockwise in that area of the Bering Sea, and this could generate the differences that are observed in the data. In any case the stations have been treated not as duplicates but as individual stations.

The distribution of C_1-C_4 hydrocarbons in the water column is highly variable, particularly in shallow-water environments. The variability arises from the various modes of production: biogenic, petrogenic (sediments), and photochemical (dissolved organic material reactions). There have been several attempts to establish ratios of these hydrocarbons to indicate possible sources [3,4].

In the upper layers of the open ocean from 0 to 150 meters, pronounced concentration peaks are quite often observed, with the olefins generally being higher in concentration than their saturated homologs. During this cruise those stations considered as open ocean fit the general pattern. This nonhomogeneous distribution suggests the existence of processes occurring at rates faster than physical mixing rates. Laboratory experiments with marine organisms have shown that unsaturated hydrocarbons such as C_2H_4 and C_3H_6 are produced while the saturated homologs are not [5]. The existence of similar phytoplankton distributions in the open ocean suggests that there may be some correlation between these two parameters. Lack of biological data for this cruise does not permit peaks of unsaturated-hydrocarbon concentrations to be correlated with biogenic processes.

Methane concentrations in the open-ocean zone do not show any subsurface maxima. In light of previous published data, this situation is not unusual. If one takes all the CH_4 values for the 6°C water, the values are all quite close and are highest at the shallow-water stations. This pattern for the values indicates that the concentrations in the open-ocean stations could be the result of offshore water movement and dilution with water of lesser methane concentrations. Ethane and propane concentrations decrease quite rapidly with depth. Again this pattern fits the general pattern of the open ocean. The consumption mechanisms that decrease the ethane and propane concentrations are unknown.

In the shallow-water environment the values are quite different but not unexpected. The shallow-water portion of the cruise track is characterized by an extremely strong thermocline which results in an equally strong pycnocline. This pycnocline effectively places a barrier between the mixed layer (10 meters deep) and the rest of the water column. Above this cap the values for all the light hydrocarbons are approximately those of the open-ocean stations. However, below this cap methane, ethane, and propane concentrations increase by factors of 2 or 3 or more. At first glance there appears to be little if any flux across this barrier. The lack of closely spaced sampling does not allow any realistic calculations of flux across this pycnoline.

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These high values for saturated hydrocarbons persist out into the intermediate zone at deeper depths. Unfortunately the lack of deep samples at the open-ocean stations prevents us from determining the extent of this shallow shelf water. The general current circulation is counterclockwise. One could then expect that the concentrations in the western portion of the track may be the result of in situ production and possible advection from the eastern portion of the track. Some local current measurements would be necessary for meaningful predictions of source locations and production rates.

The unsaturated hydrocarbons in the shallow water behave somewhat similarly to those at the open-ocean stations. The concentrations are relatively similar, and subsurface maxima are present. In several cases the subsurface maxima occur below the pycnocline. This is unusual and at present cannot be explained.

The intermediate zone is exactly that; the changeover from the shallow-water environment to open-ocean profiles is found here. Again the changes which are present are not too different from what one would expect from this type of environment.

Carbon monoxide distributions are extremely complex. It has been shown that the production of carbon monoxide depends on the amount of radiation available and biological productivity [6]. During this cruise stations were occupied at numerous times of the day and under a number of different weather conditions. Hence it is nearly impossible to give any insight into the distribution of this trace gas except for some very broad statements. Carbon monoxide values at stations during restricted incident radiation were much less than those at stations during high incident radiation. Phytoplankton populations are important in carbon monoxide production (high primary productivity resulting in high CO concentrations). The carbon monoxide values decrease rapidly with depth in all cases. This follows the pattern that has been found throughout the world oceans.

In conclusion, the area surveyed is not vastly unique from most ocean environments. Possibly some of the high concentrations of saturated compounds may be transported from the Norton Sound area. This area has known petroleum seeps and may be an important source for the present sampling area [7]. The unsaturated compounds exhibit some subsurface maxima, but the causes cannot be fully explored due to the unavailability of biological data.

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Appendix

CONCENTRATIONS OF DISSOLVED GASES

The following is a list of the methane (CH_4), ethane (C_2H_6), ethylene (C_2H_4), propane (C_3H_8), propylene (C_3H_6), and carbon monoxide (CO) concentrations in the water column. For CH_4 and CO the concentrations are expressed in units of 10^{-5} ml/l (ml of gas per liter of water). The other hydrocarbons are expressed in units of 10^{-6} ml/l.

Depth	Station	CH_4	CO	C_2H_6	C_2H_4	C_3H_8	C_3H_6
0 m	1	6.2	6.1	0.6	2.2	0.2	0.5
	25	5.9	17.8	0.2	2.1	0.2	0.8
10 m	1	6.2	5.9	0.5	1.6	0.2	0.3
	25	5.4	23.7	0.2	1.8	0.2	0.6
25 m	1	9.0	2.4	0.6	2.0	0.3	0.2
	25	5.6	9.5	0.2	1.8	0.2	0.7
50 m	1	10.1	1.4	0.3	1.5	0.2	0.1
	25	16.8	0.5	0.3	0.8	0.3	0.1
75 m	1	10.1	3.1	0.4	1.7	0.2	0.3
	25	12.7	0.8	0.3	0.7	0.2	0.2
0 m	2	5.7	5.9	0.2	1.8	0.1	0.8
	26	7.6	17.8	0.2	2.1	0.2	0.8
10 m	2	6.2	5.9	0.5	1.6	0.2	0.3
	26	6.4	12.0	0.3	2.3	0.6	0.9
25 m	2	9.0	2.4	0.6	2.0	0.3	0.2
	26	6.4	4.9	0.2	2.2	0.6	0.8
50 m	2	7.0	1.4	0.3	1.5	0.2	0.1
	26	8.3	0.8	0.2	1.6	0.7	0.4
75 m	2	10.1	3.1	0.4	1.7	0.2	0.3
	26	9.1	0.8	0.1	0.9	0.4	0.3
0 m	3	5.7	5.5	0.3	2.1	0.2	0.7
	27	5.6	4.7	0.2	1.8	0.2	0.9
10 m	3	5.8	4.6	0.4	2.0	0.1	0.6
	27	----- lost -----					
25 m	3	6.1	1.9	0.5	2.4	0.2	0.4
	27	5.6	3.1	0.2	2.1	0.3	0.8
50 m	3	6.9	0.6	0.1	1.2	0.2	0.3
	27	6.6	0.8	0.2	1.3	0.3	0.3
75 m	3	7.3	1.0	0.1	0.9	0.2	0.2
	27	6.6	0.6	0.2	0.9	0.2	0.2

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Depth	Station	CH_4	CO	C_2H_6	C_2H_4	C_3H_8	C_3H_6
0 m	4	5.4	4.2	0.5	1.5	0.1	0.7
	28	5.5	2.7	0.2	1.8	0.2	0.7
10 m	4	6.9	1.0	0.5	1.0	0.2	0.1
	28	5.4	2.6	0.2	1.6	0.2	0.7
25 m	4	7.0	0.6	0.4	0.9	0.2	0.1
	28	6.7	0.4	0.2	1.9	0.3	0.3
50 m	4	7.4	0.3	0.4	0.7	0.2	0.1
	28	7.0	0.2	0.2	1.1	0.2	0.1
75 m	4	7.3	0.4	0.3	0.6	0.1	0.1
	28	7.3	0.4	0.1	0.7	0.2	0.2
0 m	5	5.7	3.5	0.2	1.9	0.2	0.8
	29	5.2	4.2	0.2	1.6	0.2	0.7
10 m	5	5.7	4.7	0.2	2.1	0.2	0.6
	29	5.6	4.3	0.2	1.9	0.2	6.9
25 m	5	7.4	2.2	0.3	2.6	0.3	0.4
	29	5.5	2.9	0.2	1.8	0.2	0.7
50 m	5	8.4	1.3	0.2	1.8	0.2	0.7
	29	5.7	2.4	0.2	1.6	0.2	0.5
75 m	5	8.2	1.4	0.2	1.2	0.2	0.6
	29	6.4	0.9	0.2	0.8	0.2	0.2
0 m	6	6.7	3.7	0.2	2.0	0.3	0.9
	30	5.2	4.0	0.2	1.8	0.2	0.9
10 m	6	5.7	3.2	0.2	1.7	0.2	0.7
	30	5.0	4.1	0.2	1.6	0.1	0.7
25 m	6	6.4	2.9	0.3	1.9	0.3	0.5
	30	6.1	1.6	0.2	2.3	0.3	0.7
50 m	6	7.3	1.5	0.2	1.0	0.2	0.2
	30	6.7	0.5	0.1	1.1	0.2	0.2
75 m	6	7.5	1.2	0.1	0.6	0.2	0.1
	30	6.8	0.6	0.2	0.5	0.1	0.1

Depth	Station	CH_4	CO	C_2H_6	C_2H_4	C_3H_8	C_3H_6
0 m	7	6.0	3.4	0.2	2.2	0.2	1.1
	31	5.0	7.6	0.2	1.4	0.2	0.8
10 m	7	5.5	5.4	0.3	2.1	0.2	0.7
	31	----- no sample -----					
25 m	7	6.2	2.7	0.3	1.6	0.2	0.5
	31	5.3	2.8	0.2	1.6	0.2	0.7
50 m	7	6.5	1.0	0.2	0.9	0.1	0.2
	31	6.6	0.3	0.2	0.8	0.2	0.2
75 m	7	7.0	1.0	0.2	0.5	0.2	0.2
	31	6.7	0.2	0.2	0.8	0.1	0.1
0 m	8	5.6	3.0	0.2	2.1	0.3	1.4
	32	5.2	3.9	0.2	1.5	0.2	0.9
10 m	8	5.5	2.9	0.1	1.7	0.2	0.9
	32	5.2	4.4	0.2	1.6	0.2	0.8
25 m	8	6.2	2.0	0.5	1.8	0.3	0.5
	32	6.3	2.2	0.2	1.8	0.3	0.4
50 m	8	6.0	2.2	0.4	1.9	0.2	0.2
	32	6.6	0.7	0.4	0.6	0.2	0.2
75 m	8	8.5	1.0	0.4	0.5	0.2	0.2
	32	7.5	0.6	0.3	0.4	0.2	2.0
0 m	9	5.7	3.2	0.4	3.2	0.3	1.3
	33	5.2	14.9	0.2	2.1	0.2	1.0
10 m	9	5.6	5.7	0.2	1.9	0.3	1.1
	33	4.9	13.8	0.2	2.0	0.2	0.8
25 m	9	7.0	2.1	0.8	1.9	0.4	0.3
	33	5.6	3.9	0.4	1.9	0.3	0.3
50 m	9	8.1	0.9	0.7	1.0	0.3	0.2
	33	6.6	1.8	0.6	1.1	0.3	0.2
75 m	9	8.6	1.0	0.8	1.0	0.3	0.3
	33	7.6	1.1	0.7	0.9	0.3	0.2

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Depth	Station	CH_4	CO	C_2H_6	C_2H_4	C_3H_8	C_3H_6
0 m	10	5.4	6.1	0.1	1.4	0.2	0.7
	34	4.9	22.1	0.2	1.1	0.2	0.6
10 m	10	5.1	8.3	0.1	1.4	0.1	0.8
	34	5.0	16.4	0.2	1.2	0.1	0.6
25 m	10	5.3	8.0	0.2	1.2	0.1	0.6
	34	6.7	1.4	0.2	2.1	0.3	0.2
50 m	10	7.6	1.6	0.8	1.5	0.4	0.1
	34	7.8	0.6	1.1	1.3	0.5	0.1
75 m	10	8.4	0.3	1.1	1.5	0.5	0.3
	34	7.8	0.4	0.8	0.9	0.4	0.1
0 m	11	6.0	5.6	0.3	1.7	0.2	0.8
	35	5.2	9.4	0.2	1.6	0.1	0.7
10 m	11	5.0	4.9	0.2	1.3	0.1	0.6
	35	6.0	5.4	0.2	1.7	0.2	0.8
25 m	11	8.4	1.2	0.4	2.4	0.4	0.5
	35	7.1	0.8	0.3	2.2	0.4	0.4
50 m	11	9.9	0.5	0.6	1.2	0.3	0.4
	35	8.6	0.3	0.6	1.3	0.3	0.1
65 m	11	9.3	0.4	0.6	1.2	0.3	0.3
	35	8.4	0.3	0.6	1.2	0.3	0.1
0 m	12	6.2	8.7	0.2	1.9	0.2	0.8
	36	5.2	6.9	0.2	1.5	0.1	0.8
10 m	12	5.7	6.2	0.2	1.7	0.2	0.8
	36	5.4	7.5	0.2	1.7	0.2	0.7
25 m	12	10.7	1.7	0.7	1.5	0.4	0.3
	36	7.1	0.8	0.3	2.2	0.4	0.4
50 m	12	11.0	1.7	0.7	1.6	0.4	0.3
	36	9.3	1.0	0.7	1.4	0.3	0.2
75 m	12	----- no sample -----					
	36	----- no sample -----					

Depth	Station	CH_4	CO	C_2H_6	C_2H_4	C_3H_8	C_3H_6
0 m	13	5.6	8.6	0.2	1.7	0.1	0.7
	37	5.5	3.9	0.2	2.1	0.2	0.8
10 m	13	5.7	8.5	0.2	1.7	0.1	0.7
	37	5.3	2.1	0.2	1.6	0.1	0.7
25 m	13	9.1	1.1	0.7	1.6	0.4	0.2
	37	6.8	2.0	0.3	1.6	0.2	0.4
50 m	37	8.1	----- lost ----- 0.4	0.6	1.2	0.3	0.2
65 m	13	9.6	0.9	0.6	1.1	0.4	0.2
	37	8.3	0.3	0.9	0.8	0.3	0.2
0 m	14	5.5	8.2	0.2	1.5	0.1	0.8
	38	5.1	5.5	0.2	1.5	0.2	0.7
10 m	14	5.9	6.9	0.2	1.8	0.1	0.8
	38	5.2	4.9	0.2	1.4	0.1	0.6
25 m	14	11.0	1.5	0.9	1.4	0.4	0.2
	38	7.5	0.4	0.7	1.4	0.4	0.3
50 m	14	9.6	0.6	0.8	1.4	0.4	0.2
	38	8.0	0.1	0.8	1.2	0.4	0.1
75 m	14	----- no sample -----					
	38						
0 m	15	5.5	5.3	0.2	2.2	0.2	0.9
	39	5.2	6.4	0.2	1.6	0.2	0.7
10 m	15	5.9	3.5	0.2	1.8	0.2	0.5
	39	5.1	4.8	0.2	1.6	0.1	0.8
25 m	15	14.7	0.4	0.7	2.1	0.5	0.3
	39	18.6	0.1	0.9	1.7	0.4	0.1
45 m	15	14.7	0.5	1.4	1.5	0.5	0.2
	39	18.6	0.2	0.8	1.8	0.4	0.1
75 m	15	----- no sample -----					
	39						

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Depth	Station	CH_4	CO	C_2H_6	C_2H_4	C_3H_8	C_3H_6
0 m	16	5.8	16.1	0.2	2.2	0.2	0.9
	40	5.1	3.4	0.2	1.4	0.1	0.7
10 m	16	21.5	1.0	0.7	2.0	0.4	0.2
	40	5.4	2.4	0.2	1.3	0.1	0.6
25 m	16	----- lost -----					
	40	18.4	0.3	0.9	1.8	0.4	0.1
50 m	16	20.7	1.5	0.9	1.9	0.4	0.2
	40	18.6	0.3	0.8	1.7	0.4	0.1
75 m	16	----- no sample -----					
	40						
0 m	17	6.4	7.0	0.2	1.9	0.2	1.0
	41	5.6	5.7	0.2	1.6	0.2	0.8
10 m	17	6.3	6.3	0.2	2.0	0.1	0.7
	41	5.4	5.4	0.2	1.4	0.1	0.7
25 m	17	16.4	1.5	0.8	2.2	0.4	0.2
	41	22.3	1.3	0.6	2.0	0.3	0.2
40 m / 35 m	17	16.6	1.2	1.2	1.8	0.4	0.2
	41	18.1	0.9	0.9	1.8	0.4	0.2
75 m	17	----- no sample -----					
	41						
0 m	18	6.3	4.2	0.2	1.4	0.2	0.9
	42	5.4	8.6	0.2	1.3	0.1	0.8
10 m	18	6.6	3.4	0.2	1.4	0.1	0.8
	42	5.5	2.6	0.2	1.5	0.1	0.7
25 m	18	29.7	1.1	0.6	2.2	0.3	0.3
	42	20.5	0.2	0.4	1.9	0.3	0.4
40 m / 35 m	18	30.4	0.9	0.7	2.2	0.4	0.4
	42	24.8	0.7	0.8	1.8	0.3	0.3
75 m	18	----- no sample -----					
	42						

Depth	Station	CH_4	CO	C_2H_6	C_2H_4	C_3H_8	C_3H_6
0 m	19	12.9	6.8	0.3	2.3	0.3	2.3
	43	10.5	7.7	0.3	2.6	0.3	1.1
10 m	19	13.5	0.8	0.3	2.7	0.2	0.7
	43	12.3	1.3	0.4	2.6	0.3	0.8
25 m	19	22.0	0.5	1.3	2.6	0.4	0.9
	43	16.5	0.2	0.9	2.4	0.3	0.7
50 m	19	—— no sample ——					
	43	—— no sample ——					
75 m	19	—— no sample ——					
	43						
0 m	20	5.9	3.8	0.1	1.6	0.1	0.7
	44	5.0	2.4	0.2	1.4	0.2	0.8
10 m	20	6.1	4.9	0.2	1.6	0.2	0.6
	44	5.3	1.5	0.2	1.7	0.2	0.8
25 m	20	16.4	2.1	0.3	2.1	0.3	0.3
	44	—— lost ——					
45 m	20	16.5	2.4	0.8	2.4	0.4	0.3
	44	16.6	0.3	0.6	2.2	0.4	0.2
75 m	20	—— no sample ——					
	44						
0 m	21	5.8	6.1	0.4	1.8	0.2	0.8
	45	4.9	7.7	0.2	1.9	0.2	1.1
10 m	21	5.9	6.4	0.2	1.9	0.2	0.9
	45	4.7	2.3	0.2	1.1	0.2	0.7
25 m	21	11.2	0.7	0.7	1.6	0.3	0.3
	45	9.7	1.2	0.4	1.9	0.4	0.3
50 m	21	10.8	0.5	0.6	1.6	0.3	0.2
	45	9.7	0.7	0.6	1.6	0.3	0.1
58 m	21	10.8	0.5	0.5	1.7	0.3	0.2
	45	—— no sample ——					

Depth	Station	CH_4	CO	C_2H_6	C_2H_4	C_3H_8	C_3H_6
0 m	22	7.0	2.7	0.2	3.0	0.5	1.2
	46	5.1	5.5	0.2	2.1	0.2	0.9
10 m	22	6.7	3.0	0.3	2.8	0.3	1.1
	46	5.5	3.0	0.3	2.2	0.3	1.2
25 m	22	9.0	0.8	0.7	3.1	0.5	0.8
	46	7.3	0.4	0.3	2.2	0.4	0.2
50 m	22	9.0	0.5	0.8	2.1	0.5	0.4
	46	7.4	0.3	0.4	2.2	0.2	0.2
75 m	22	----- no sample -----					
	46	----- no sample -----					
0 m	23	5.5	2.9	0.2	1.9	0.2	0.8
	47	4.8	5.1	0.2	2.0	0.2	0.8
10 m	23	----- lost -----					
	47	5.0	4.9	0.2	1.9	0.2	0.8
25 m	23	7.0	1.2	0.6	1.9	0.3	0.1
	47	5.8	3.1	0.2	2.2	0.3	0.6
50 m	23	8.5	0.2	0.2	1.5	0.3	0.1
	47	6.1	0.9	0.3	1.5	0.2	0.6
75 m	23	8.5	0.3	0.8	1.0	0.3	0.1
	47	6.4	0.5	0.4	1.2	0.2	0.3
0 m	24	5.7	7.6	0.2	2.2	0.2	1.1
	48	4.7	0.8	0.2	1.9	0.2	0.7
10 m	24	5.8	4.3	0.2	2.3	0.2	1.0
	48	4.8	1.0	0.2	1.8	0.2	0.9
25 m	24	6.5	1.2	0.2	2.4	0.3	0.6
	48	5.6	0.4	0.2	2.4	0.3	0.6
50 m	24	7.3	1.5	0.4	1.0	0.3	0.2
	48	6.1	0.2	0.3	1.5	0.2	0.6
75 m	24	7.3	0.5	0.3	0.6	0.2	0.1
	48	5.6	0.2	0.4	1.2	0.2	0.3

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